

REMARKS

The Office Action dated November 4, 2009, has been received and carefully noted. The above amendments and the following remarks are being submitted as a full and complete response thereto.

Claims 13 – 19 are rejected. Claim 13 is amended, and Claim 14 is cancelled and added into Claim 13. Claims 20 – 23 are withdrawn from further consideration in this application. Thus, Claims 13 and 15-23 are pending in this application. Support for the amendments may be found in the specification as originally filed. Applicants submit that no new matter is added and that no new issues are raised requiring a further search. Applicants respectfully request reconsideration and withdrawal of the rejections.

Claim Rejections – 35 U.S.C. §103

Claims 13 – 18 are rejected under 35 U.S.C. §103(a) as being unpatentable over Kajikawa et al. (U.S. Patent No. 4, 309, 227, hereinafter “Kajikawa”) in view of JP 2000-045061 (hereinafter “JP ‘061”) as stated in the Office Action dated April 21, 2009. Applicants respectfully traverse this rejection.

Claim 13 is directed to a nitriding treatment method for performing a nitriding treatment for a workpiece in a heat treatment furnace comprising several specific steps. First, a pulse voltage is applied between the heat treatment furnace and the workpiece having a predetermined current density at a frequency of not less than 1 kHz to start heating the workpiece by means of generated glow discharge with additional heating by using a heating element arranged around the workpiece. Second, upon a temperature

of the workpiece initially arriving above 350° C, the current density of the pulse voltage is decreased, and the workpiece is heated up to a desired nitriding treatment temperature by the heating element arranged around the workpiece. The heating effected in the second step is such that an amount of heat generated by the heating element is higher than that at any time in the first step. The actual nitriding treatment is performed by means of nitrogen ion or nitrogen radical generated by the glow discharge.

Kajikawa has been carefully presented and the teachings thereof set forth in the prior response of August 25, 2009 which is incorporated herein in its entirety by reference. The Examiner is respectfully referred to the same.

In addition, the Examiner is requested to consider that glow discharge provides a uniform temperature distribution. However, a workpiece heated by the glow discharge undesirably radiates its own heat. On the other hand, although a workpiece itself does not radiate heat when it is heated by a heating element, a number of heating elements are required to achieve uniform temperature distribution of the workpiece. The object of the present invention is to avoid the above-mentioned disadvantages due to the differences in temperature distribution between the use of glow discharge and the use of one or more heating elements.

To achieve the object, the present invention mainly utilizes the glow discharge at the initial step which requires high energy, and afterwards mainly utilizes the heating element. Specifically, according to the nitriding treatment method of the present invention, the current density of the glow discharge is decreased in the second step,

whereas the output of the heating element is raised up in the second step, whereby it is possible to easily control the temperature of the workpiece at a desired level.

In contrast, the Kajikawa reference performs complicated controls of the current density of the glow discharge and the output of the heating element.

Further, referring to FIG. 3(B) of the Kajikawa as depicted in the previous response incorporated herein, it is clear that the output of the heating element is decreased at time t_2 . In response to the previous arguments, the Examiner mentions that because the workpiece is heated up at the beginning of the second step despite the voltage level drop of the glow discharge, the heat generated by the heating element in the beginning of the second step is higher than that at any time in the first step (please see page 5, lines 4-12 of the Office Action). However, it seems that the Examiner does not recognize that in fact the workpiece can be heated up due to its own heat radiation caused by the glow discharge. That is, the Examiner is attributing all of the increase in temperature to be due to the heating element. It is submitted that the clear teachings of FIGs 3(B) and 4(B) are contrary to the Examiner's holding. The heat generated by the heating element cannot be higher than in the first step when the patent clearly shows "the heat-radiating element output" as declining in both figures.

With respect to the Examiner's statements in lines 13 – 17 of page 5 of the Office Action, it is apparent that the effects of glow discharge and the persistency and radiation of heat generated from the workpiece itself are not understood. It is not obvious that the decrease in glow discharge voltage would have to be gradual since a step decrease (as clearly shown in both FIGs 3(B) and 4(B)) would not produce an abrupt decrease in heat input. Rather, the amount of self generated heat would slowly decrease. If the Examiner

was correct in reasoning the effects of the voltage drop as shown in both FIGs 3(B) and 4(B) would effect a temperature drop in both of FIGs 3(A) and 4(A) which is not the case.

Although the Kajikawa reference utilizes both the glow discharge and the heating element, the current density and the voltage level of the glow discharge and the output of the heating element are mere parameters arbitrarily set. In addition, the Kajikawa reference mentions at the upper right column of page 4 that the workpiece may be heated only by the glow discharge. As is clear from this description, the Kajikawa reference is not aware of the disadvantages of the glow discharge.

In the present invention, both the glow discharge and the heating element are utilized in the first step, and then the current density of the glow discharge is decreased and the output of the heating element is increased in the second step, so that the workpiece can be efficiently heated for nitriding treatment while the necessary nitrogen ions or radicals are still being sufficiently produced by the glow discharge.

In contrast, in the Kajikawa reference, the output of the heating element is clearly once reduced. Thus, the Kajikawa reference teaches away from the present invention.

For at least the above reasons and those set forth in the previous response, Applicants respectfully request reconsideration and withdrawal of the rejection of Claims 13 – 18 under 35 U.S.C. §103(a) over Kajikawa in view of JP '061.

Claim 19 is rejected under 35 U.S.C. §103(a) as being unpatentable over Kajikawa in view of JP '061 as applied to claim 13 above, and further in view of JP 09-079912 (hereinafter "JP '912") as stated in the Office Action dated April 21, 2009. Applicants continue to respectfully traverse this rejection.

The reasons of record for traversing the rejection set forth in the previous response are also incorporated by reference with regard to this rejection.

In the Office Action, the Examiner is equating the sample 1 of the reference with the claimed dummy workpiece. This is clearly erroneous in that the sample 1 of the reference is a simulation of the workpiece being treated. Claim 19 requires the presence in the same furnace at the same time of the dummy workpiece and the actual workpieces being treated, with the simultaneous detecting of a radiation temperature of the workpiece being treated and a contact temperature of the dummy workpiece, and correcting the radiation temperature of the actual workpiece being treated with said temperature difference between the real-time radiation temperature of the workpiece being treated and the real-time contact temperature of the dummy workpiece. Simulation of an effect is not a teaching of actual measurement and use of such measurement of an effect.

For at least the above reasons and those set forth in the previous response, Applicants respectfully request reconsideration and withdrawal of the rejection of Claim 19 under 35 U.S.C. §103(a) over Kajikawa in view of JP '061, and further in view of JP '912.

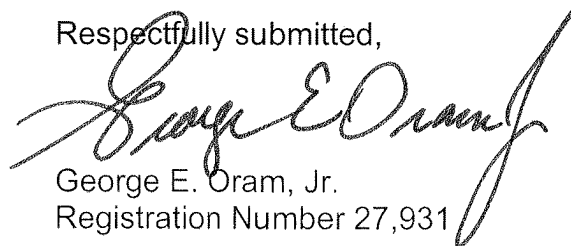
Consequently, it is strongly contended that clear differences exist between the present invention as claimed in Claims 13 and 15 – 19 and the prior art relied upon. It is further contended that these differences are more than sufficient that the present invention as claimed would not have been rendered obvious to a person of ordinary skill in the art viewing those references.

Conclusion

Applicants respectfully submit that this application is in condition for allowance and such action is earnestly solicited. If the Examiner believes that anything further is desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned representative at the telephone number listed below to schedule a personal or telephone interview to discuss any remaining issues.

In the event that this paper is not being timely filed, the Applicants respectfully petition for an appropriate extension of time. Any fees for such an extension, together with any additional fees that may be due with respect to this paper, may be charged to Counsel's Deposit Account Number 01-2300, referencing Docket Number 025416-00024.

Respectfully submitted,



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